CLAIM AMENDMENTS

1. (Amended) ~~An~~ A broadband optical switching apparatus comprising

an imaging arrangement including a first and second broadband couplers having only three imaging waveguide arms connected therebetween;

the first coupler including at least one input connected as an input waveguide of the switching apparatus for receiving a broadband optical signal and three outputs connected to the three imaging arms;

the second coupler is a star coupler consisting of a first and second radial array separated by a slab waveguide, the three imaging arms being connected to three central waveguides of the first radial array, and two central waveguides of the second radial array being connected to a first and a second ~~two~~ output waveguides of the switching apparatus;

the three imaging arms including a top, a central, and a bottom imaging arm;

at least two of the three imaging arms including wavelength adjusters to control optical path lengths through the three arms, said adjusters adjusted to produce equal optical path lengths from the input waveguide to the ~~a~~ first output waveguide thereby maximizing broadband optical signal power transfer from the input waveguide to the first output waveguide;

the spacing between the two central waveguides of the second radial array being selected so as to minimize power transfer to the second output waveguide; and

wherein the power transfer to the top, central, and bottom imaging arms is controlled so that the difference between the combined power transferred to the top and bottom imaging arm and the power transferred to the central imaging arm is controlled to have a ratio close to one so that the crosstalk at a center wavelength of the broadband optical signal does not exceed ~~within a~~ predetermined value.

2. (Amended) The optical switching apparatus of claim 1 wherein the combined power transferred to the top and the bottom imaging arm is smaller than the power transferred to ~~a~~ the central imaging arm.

3. (Original) The optical switching apparatus of claim 1 wherein the predetermined maximum value is about zero.

4. (Original) The optical switching apparatus of claim 1 wherein the first coupler is a star coupler consisting of a first and second radial array separated by a slab waveguide, the at least one input waveguide of the switching apparatus being connected to a waveguide of the first radial array, and the three imaging arms being connected to three central waveguides of the second radial array.

5. (Original) The optical switching apparatus of claim 1 wherein the spacing between the three central waveguides of the first radial array is a_w, the spacing between the central waveguides of the second radial array is a_x, the distance between the two foci of the first and second arrays is R, the effective refractive index of the slab waveguide is n, l_0 is a specified design wavelength within the wavelength range of specified operation, and where $R = (2a_x a_w n)/l_0$.

6. (Original) The optical switching apparatus of claim 5 wherein the second radial array of the second coupler includes at least two additional waveguides that straddle the two central waveguides of the second radial array and are spaced a_x therefrom.

7. (Original) The optical switching apparatus of claim 4

wherein the first coupler has the first radial array including two central waveguides connected to two input waveguides of the switching apparatus; and

wherein the spacing of the central waveguides of the first radial array of the first coupler connected to the two input waveguides is properly chosen so that whenever maximum power transfer is produced from either input waveguide to either output waveguide this will also produce efficient power transfer between the other two waveguides.

8. (Original) The optical switching apparatus of claim 7 wherein the first radial array of the first coupler includes at least two additional waveguides that straddle the two central waveguides of the first radial array and are spaced a_x therefrom.

9. (Original) The optical switching apparatus of claim 1 where, for an optical input signal received at the input waveguide of the optical switching apparatus, said spacing between the two central waveguides of the second radial array is selected so as to maximize the stopband width determined by the wavelengths of the optical input signal for which the optical switching apparatus has a crosstalk transfer function that is less than a predetermined maximum value, said crosstalk transfer function being defined as the crosstalk power transferred at

a particular wavelength to the second output waveguide when unit input power is applied to the input waveguide at that wavelength.

10. (Original) The optical switching apparatus of claim 9 wherein said crosstalk transfer function has a stopband characterized by a minimum point of essentially zero crosstalk.

11. (Amended) The optical switching apparatus of claim 9 wherein said crosstalk transfer function has a stopband ~~stoband~~ with two separate minima of essentially zero crosstalk.

12. (Original) The optical switching apparatus of claim 1 wherein the optical transmission is reversed, so that the two output waveguides become input waveguides and the arrangement is capable of connecting either input waveguide to an output waveguide.

13. (Original) The optical switching apparatus of claim 12 being part of a dilated switching arrangement connected to several input signals and several output ports, wherein each switching configuration of the dilated arrangement

consists of separate active paths, each connecting a particular input signal to a particular output port, and wherein each crosstalk path between any two active paths is blocked by at least two switching apparatuses, each realized as in claim 12.

14. (Original) The optical switching apparatus of claim 12 being part of a dilated switching arrangement connected to several input signals and several output ports, wherein each switching configuration of the dilated arrangement consists of separate active paths, each connecting a particular input signal to a particular output port, and wherein each crosstalk path between any two active paths is blocked by at least two switching apparatuses, each realized as in claim 1.

15. (Amended) The optical switching apparatus of claim 12 being connected as each of two 2x1 output switches ~~part~~ of a 2x2 dilated crossbar arrangement having a first column of two optical switching apparatuses connected as 1x2 input switches and a second column of two of said optical switching apparatuses connected as 2x1 output switches, where each of two inputs of the 2x2 dilated crossbar arrangement ~~input thereof~~ is connected to an input of a different ~~optical switching apparatus operated as a~~ 1x2 input switch, where each of the two outputs of each 1x2 input switch connects to a different input of a different one of the 2x1 output switches, and each of two outputs of the 2x2

dilated crossbar arrangement ~~output thereof~~ is connected to an output of ~~a different optical switching apparatus operated as~~ a 2x1 output switch.

16. (Amended) The optical switching apparatus of claim 1 being connected as each of two 1x2 input switches ~~being part~~ of a 2x2 dilated crossbar arrangement having a first column of two of said optical switching apparatuses connected as 1x2 input switches and a second column of two optical switching apparatuses connected as 2x1 output switches where- each of two inputs ~~input~~ of the 2x2 dilated crossbar arrangement ~~thereof~~ is connected to an input of a different ~~a different optical switching apparatus operated as a~~ 1x2 input switch, where each of the two outputs of each 1x2 input switch connects to a different input of a different one of the 2x1 output switches, and where each of two outputs ~~output~~ of the 2x2 dilated crossbar arrangement ~~thereof~~ is connected to an output of a different ~~a different optical switching apparatus operated as a~~ 2x1 output switch.

17. (Original) The optical switching apparatus of claim 16 wherein at least one crosstalk transfer function of said 2x2 dilated crossbar arrangement has two separate minima of negligible crosstalk.

18. (Original) The optical switching apparatus of claim 16 wherein said 2x2 dilated crossbar arrangement has a crosstalk transfer function that has four separate minima of negligible crosstalk.

19. (Amended) The optical switching apparatus of claim 1 being connected as 1x2 input switches ~~part~~ of a dilated crossbar arrangement including an input stage having a column of said optical switching apparatuses connected as 1x2 input switches, an intermediate stage, and an output stage having a column of 2x1 output switches,

where each input of the dilated crossbar arrangement ~~input stage is~~connects ~~connected~~ to an input to a different ~~optical switching apparatus operated as a~~one of the 1x2 input switches~~switch~~,

where each output of the dilated crossbar arrangement connects~~output stage is connected~~ to an output of a a different ~~optical switching apparatus operated as a~~one of the 2x1 output ~~switch~~switches, and

where the intermediate stage includes a plurality of switches, which provide a connection~~s~~ between each of the outputs of the 1x2 input switches and inputs to the plurality of switches and which provide a connection between outputs of the

plurality of switches and ~~of the input stage and~~ each of the inputs to the 2x1 input switches of the output stage.

20. (Original) The optical switching apparatus of claim 19 wherein said dilated crossbar arrangement has a crosstalk transfer function that has at least two separate minima of essentially zero crosstalk.

21. (Amended) The optical switching apparatus of claim 12 being connected as 2x1 output switches ~~part~~ of a dilated Clos switching arrangement including an input stage having a column of 1x2 input switches, an intermediate stage, and an output stage having a column of said optical switching apparatuses connected as 2x1 output switches,

wherein each input of the Clos switching arrangement connects to an input of a different one of the 1x2 input switches~~the input stage includes at least one input switch, each input switch being connected to a plurality of different inputs of the Clos switching arrangement~~;

where each output of the Clos switching arrangement connects to a different one of the 2x1 output switches~~wherein the output stage includes at least one output switch, each output switch being connected to a plurality of different outputs of the Clos switching arrangement~~; and

wherein the intermediate stage includes a plurality of intermediate switches, which provide a connection between each of the outputs of the 1x2 input switches and inputs to the plurality of intermediate switches and which provide a connection between outputs of the plurality of intermediate switches and each of the inputs to the 2x1 input switches of the output stage~~each intermediate switch providing a connection between each input switch and each output switch~~.

22. (Amended) The optical switching apparatus of claim 1 being connected as 1x2 input switches ~~part~~ of a dilated Clos switching arrangement including an input stage having a column of said optical switching apparatuses connected as 1x2 input switches, an intermediate stage, and an output stage having a column of 2x1 output switches,

wherein each input of the Clos switching arrangement connects to an input of a different one of the 1x2 input switches~~wherein the input stage includes at least one input switch, each input switch being connected to a plurality of different inputs of the Clos switching arrangement~~;

where each output of the Clos switching arrangement connects to a different one of the 2x1 output switches~~wherein the output stage includes at least one output~~

~~switch, each output switch being connected to a plurality of different outputs of the Clos switching arrangement~~; and

wherein the intermediate stage includes a plurality of intermediate switches, which provide a connection between each of the outputs of the 1x2 input switches and inputs to the plurality of intermediate switches and which provide a connection between outputs of the plurality of intermediate switches and each of the inputs to the 2x1 input switches of the output stage~~each intermediate switch providing a connection between each input switch and each output switch~~.

23. (Original) The optical switching apparatus of claim 22 wherein at least one crosstalk transfer function of said dilated Clos switching arrangement has at least two separate minima of negligible crosstalk.

24. (Original) The optical switching apparatus of claim 1 where in response to control signals to the at least two wavelength adjusters the optical switching apparatus switches to the first output waveguide an input signal received at a first input waveguide.

25. (Original) The optical switching apparatus of claim 24 where in response to said control signals to the at least two wavelength adjusters the optical

switching apparatus switches to the second output waveguide an input signal received at a second input waveguide.

26. (Original) The optical switching apparatus of claim 1 wherein the at least one input receives a broadband wavelength division multiplexed signal which is switched to one of the outputs waveguides of the optical switching apparatus.

27. (Amended) A method of operating ~~an~~a broadband optical switching apparatus comprising

an imaging arrangement including a first and second broadband couplers having only three imaging waveguide arms connected therebetween;

the first coupler including at least one input connected as an input waveguide of the switching apparatus for receiving a broadband optical signal and three outputs connected to the three imaging arms;

the second coupler is a star coupler consisting of a first and second radial array separated by a slab waveguide, the three imaging arms being connected to three central waveguides of the first radial array, and two central waveguides of the

second radial array being connected to a first and a second ~~two~~ output waveguides of the switching apparatus; and

the three imaging arms including a top, a central, and a bottom imaging arm;

the method comprising the steps of:

adjusting the phase of an optical signal in at least two of the three imaging arms to maximize broadband optical signal power transfer from the input waveguide to the first output waveguide; and

wherein the power transfer to the top, central, and bottom imaging arms is controlled so that the difference between the combined power transferred to the top and bottom imaging arm and the power transferred to the central imaging arm is controlled to have a ratio close to one so that the crosstalk at a center wavelength of the broadband optical signal does not exceed ~~within~~ a predetermined maximum value.